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Specification of V294 I/O Module with Stretched Complementary Outputs  
(preliminary)

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## 1. Inputs and outputs for general V294

The general V294 is a pulse fanout module with sixteen LEMO connectors:

- a) Four TTL inputs with 50Ω impedance. The inputs are photo-isolated.
- b) Eight TTL outputs with 50Ω impedance;
- c) Four TTL inputs or outputs with 50Ω impedance. If an input is configured as input, it is photo-isolated. The IO port jumpers can configure them as inputs or outputs as shown in Table 1.

Jumper for IO port mode	Setting
Jp1—Jp4	Pin1 and pin 2 on: input mode Pin 2 and pin 3 on: output mode <div>+ Pin3 + Pin2 + Pin1</div>

**Table 1: Different mode for IO port**

The general V294 can be configured to different fanout mode as shown in Table 2.

Configuration for V294 (fanout)	1:12 (IN1 → OUT1-8 IO1-4)	2:12 (IN1→ OUT1-6 IN2→ OUT7-8 IO1-4)	3:12 (IN1→ OUT1-4 IN2 → OUT5-8 IN3 → IO1-4)	4:12 (IN1→OUT1-3 IN2 → OUT4-6 IN3→OUT7,8 IO1 IN4→ IO2-4)
JP9	ON	OFF	OFF	OFF
JP10	OFF	ON	OFF	OFF
JP11	OFF	OFF	ON	OFF
JP12	OFF	OFF	OFF	ON

**Table 2: Different fanout mode**

## 2. LEDs for general V294

The LEDs for each input/IO/output connector are designed to indicated a signal on the connectors. The LEDs are stretched to be visible for human eyes. If the signal is a single short positive pulse, we will see a single flash; if the signals is a serials of positive pulses, we will see many flashes; if the signal is positive at most of the time, the LED will look like always on.

## 3. Ground issue for general V294

There are two grounds on the board: digital ground and chassis ground. The digital ground is the ground of VME bus. The chassis ground is the ground of the front panel or we call the ground of chassis. Ideally, they should be connected through the chassis power supply unit. In some old chassis, these two grounds could have 5V difference. The two-ground design in V294 gives the users a choice to choose the ground of the input signals.

- a) The grounds of output and input/output LEMO connector (LEMO shell) are always connected to the chassis ground.
- b) The grounds of inputs LEMO connector can be configured as digital ground or chassis ground as shown in table 3.

Jumper for Input LEMO shell	Setting
Jp5—Jp8	ON: LEMO shell connected to chassis ground OFF: LEMO shell floating back to transmitter ground

**Table 3: Input LEMO ground setting**

- c) The chassis ground and digital ground can be connected through jumper JP17: JP17=ON for connected; JP17=OFF for no connected.

### **3. VME bus connector (P1, P2) for general V294**

The general V294 board doesn't use the VME interface. The VME interface on the PC board are for V128 module, which is a general purpose VME IO module and it shares the same PC board with V294. To make sure the norm VME operation with V294 inserted in the backplane, the A21(/iackin) and A22 (/iackout) of P1 are shorted through a wire on V294 board. All the other P1 and P2 connector pins are not connected to the board.

### **4. Board power-up for general V294**

The input vs. output relationship is controlled by the control FPGA chip (U2: Altera FLEX10K10), which is configured by the configuration PROM during the board power up. The configuration PROM is programmed through the JTAG connected during the board assembly. The content is the same for a general V294 pulse fanout board. However, it can be changed to other V294 version as requested by the user. The following paragraph shows a special V294 version, which is a pulse stretch module and has three pair of complementary TTL outputs on three 20-pin connectors.

### **5. Specification for pulse stretch V294**

At request of SNS control group, the general V294 module is modified to a pulse stretch module. This module have the same inputs as the general V294 module: use LEMO connectors and 50Ohm TTL signals. The outputs are modified to three 20-pin male connectors. The output signals of the board go to the 9<sup>th</sup> and the 10<sup>th</sup> pins on each connector, as shown in table 4.

Input from LEMO connector	Output on 20-pin connector
IN1	Connector 1 Pin 9: IN1 stretched to 5.15ms Pin10: ~IN1 stretched to 5.15ms
IN2	Connector 2 Pin 9: IN2 stretched to 5.15ms Pin10: ~IN2 stretched to 5.15ms
IN3	Connector 3 Pin 9: IN3 stretched to 5.15ms Pin10: ~IN3 stretched to 5.15ms

**Table 4: Specification for V294 with stretched complementary outputs**

As shown in table 4, an input pulse signal is stretched to 5.15ms and output to the 9<sup>th</sup> pin and its complementary signal is output to the 10<sup>th</sup> pin. The minimum pulse width of input signal is 100ns, which is the limit for the input photo isolator (U30--U33: 6N137). The separation between the rising edges of two contiguous input pulses is 5.15ms, otherwise the second pulse will get lost.